

## TWO NEW SPECIES OF THE *HYLA SUMICHRASTI* GROUP (AMPHIBIA: ANURA: HYLIDAE) FROM MEXICO

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*Abstract.*—Two new species belonging to the *Hyla sumichrasti* group of Mexico are described; one is from the cloud forests of the southeastern Oaxacan highlands and the other from the extremely xeric Zapotitlán Valley of Puebla. The new species from Oaxaca can be distinguished from other members of the group based on body proportions and external morphology. The new species from Puebla resembles *H. sumichrasti*, but differs in hand size and morphology, snout shape, and presence of vomerine teeth. A canonical analysis of morphometrics of the four species in the group reveals that *H. sumichrasti* and the new species from Puebla are similar, but distinguishable, whereas *H. smaragdina* and the new species from Oaxaca are distinct from the other members of the group. *Hyla sumichrasti* is reported for the first time from the state of Guerrero.

*Resumen.*—Se describen dos especies nuevas que pertenecen al grupo *Hyla sumichrasti* de México, una del bosque de neblina de las montañas del sureste de Oaxaca y la otra del valle árido de Zapotitlán en Puebla. La especie nueva de Oaxaca se puede distinguir de los otros miembros del grupo sobre la base de sus proporciones corporales y su morfología externa. La especie nueva de Puebla es similar a *H. sumichrasti*, pero tiene manos de forma y tamaño diferentes, hocico de forma diferente y dientes vomerinos. Un análisis canónico de la morfometría de las cuatro especies del grupo revela que *Hyla sumichrasti* y la especie nueva de Puebla son similares, pero se pueden distinguir mientras que *Hyla smaragdina* y la especie nueva de Oaxaca son distintas de los otros miembros del grupo. Se reporta por primera vez una población de *Hyla sumichrasti* para el estado de Guerrero.

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Nearly 20 years have passed since the description of any new members of the speciose genus *Hyla* from the vast and geographically complex regions of Mexico (see Caldwell 1974). We examined two enigmatic series of specimens belonging to the *Hyla sumichrasti* group (Duellman 1970), which is endemic to Mexico, and conclude that each represents an undescribed species.

Members of the *Hyla sumichrasti* group (*H. sumichrasti* and *H. smaragdina*, from southern and western Mexico, respectively)

have larvae with immense mouths containing three upper and seven lower tooth rows and the adults have distinctively broad, flat heads with a unique combination of cranial characters—viz. massive nasals that are in broad contact medially, a short and broad sphenethmoid, a large frontoparietal fontanelle, and absence of quadratojugals (Duellman 1970). By virtue of these characters, the group is remarkably distinct from other species groups in Middle America (Duellman 1970). Herein we describe two

new species which we place in the *H. sumichrasti* group based on the cranial and external characters of the adults.

### Materials and Methods

Terminology and measurements follow those described by Duellman (1970) and the descriptions are formatted similarly for ease of comparison. Webbing formulae for hands and feet follow Myers & Duellman (1982). All measurements were taken by the same person (JRM) using digital calipers. Observations were made under a dissecting microscope. The condition of the nasal bones was evaluated by lifting the skin of the snout posteriorly until the bones were exposed. Comparative material examined is listed in Appendix 1; specimens examined are from the collections at The University of Kansas (KU), The University of Texas at Arlington (UTA), and the California Academy of Sciences (CAS). All localities were presented in metric measurements. Localities of type specimens are presented here as they appear in the original catalogues. Small sample sizes limited comparisons and morphometric analysis to male specimens only.

Stepwise discriminant function analysis (DFA) was performed using the BMDP computer program on the following morphometric measurements (all log-transformed): (1) snout-vent length (SVL), (2) tibia length, (3) foot length, (4) head length, (5) head width, (6) anterior margin of tympanum—posterior margin of eye distance, (7) eye-nostril distance, (8) diameter of tympanum, (9) length of first finger, (10) length of third finger, and (11) diameter of disc on third finger.

### Systematics

#### *Hyla chimalapa*, new species

Figs. 1; 2A; 3A

*Holotype*.—UTA A-13365 (original number JAC 9324), a male from Colonia Rodolfo Figueroa, 19 km NW Rizo de Oro

(Chiapas), 1542 m, Oaxaca, Mexico; obtained on 4 Aug 1983 by J. A. Campbell, D. M. Hillis, and W. W. Lamar.

*Paratopotype*.—UTA A-13366, a male, other data as for holotype.

*Paratypes*.—CAS 170121, 170122, 170124, 170125, 170127, 170130, adult males, and CAS 170119, 170120, 170123, 170126, 170128, 170129, adult females, from 5–7 mi NW Rizo de Oro along road to Cerro Baul, Chiapas, Mexico, 3300 feet elev., collected by D. E. Breedlove on 19 Apr 1972; CAS 170114, an adult female from 12 mi W of Rizo de Oro (Chiapas) along ridge south of Cerro Baul, Oaxaca, Mexico, 5000 feet elev., obtained by D. E. Breedlove on 28 Apr 1972.

*Referred specimens*.—KU 179072, an adult male from 6.5 km (by road) NE Miltepec (=Nilttepec), Oaxaca, Mexico, obtained by D. R. Frost and S. Aird on 16 Jun 1977. CAS 163309, an adult female from 1.6 km W Rizo de Oro, crest of ridge between Tapanatepec and Cintalapa Valley, 853 m, Chiapas, Mexico, obtained by D. E. Breedlove on 12 Jun 1965.

*Diagnosis*.—*Hyla chimalapa* is referred to the *H. sumichrasti* group because of the broad, flat head and large nasals that are in broad contact medially. This species may be distinguished from other members of this group by the following combination of characters: (1) tympanum distinct; (2) snout acutely pointed in dorsal view and protruding, pointed in lateral view; (3) vomerine teeth absent; (4) tongue round; (5) tarsal fold distinct; (6) tibiotarsal articulation extending to snout; (7) fingers long, slender, about half webbed; (8) transverse dermal fold on heel absent; (9) ventral coloration extending from axilla onto dorsomedial surface of upper arm; and (10) row of ulnar tubercles present.

*Hyla chimalapa* differs from *H. sumichrasti* by having relatively longer legs; a relatively wider head; a distinct tympanum; round tongue; snout protruding and pointed in lateral view (Fig. 3a, c); fingers longer,



Fig. 1. *Hyla chimalapa*, holotype, UTA A-13365, photographed in life.

more slender; distinct tarsal fold present; transverse dermal fold on heel absent; dorsomedial surface of upper arm light; row of ulnar tubercles present; and vomerine teeth absent. *Hyla chimalapa* differs from *H. smaragdina* by being larger, and by having relatively longer legs; a relatively wider head; flecking on dorsum less extensive; dorsomedial surface of upper arm light; snout more pointed in dorsal and lateral view (Fig. 3a, d); tongue round; row of ulnar tubercles present; fingers relatively longer, more slender, about half webbed; transverse dermal fold on heel absent; and vomerine teeth absent. *Hyla chimalapa* differs from *Hyla xera* (described below) by being smaller, and by having relatively longer legs; snout more pointed in profile; fingers longer, more slender, about half webbed; distinct tarsal fold present; row of ulnar tubercles present; pal-

mar tubercle present; transverse dermal fold on heel absent; and dorsomedial surface of upper arm light.

*Description of holotype.*—Body robust; head as wide as body, slightly wider than long; head width 34.5 percent SVL; head length 33.7 percent SVL; snout acutely pointed in dorsal view, protruding and pointed in profile; distance from eye to nostril equal to diameter of eye; nostril four-fifths distance from eye to tip of snout; top of head flat, smooth; canthus rostralis distinct, rounded; loreal region flat; lips thin, barely flared; interorbital distance about 50 percent greater than width of eyelid; tympanum distinct with raised annulus, diameter about equal to distance from eye to tympanum; supratympanic fold thin, obscuring posterodorsal margin of tympanum, extending posteriorly from orbit, postero-

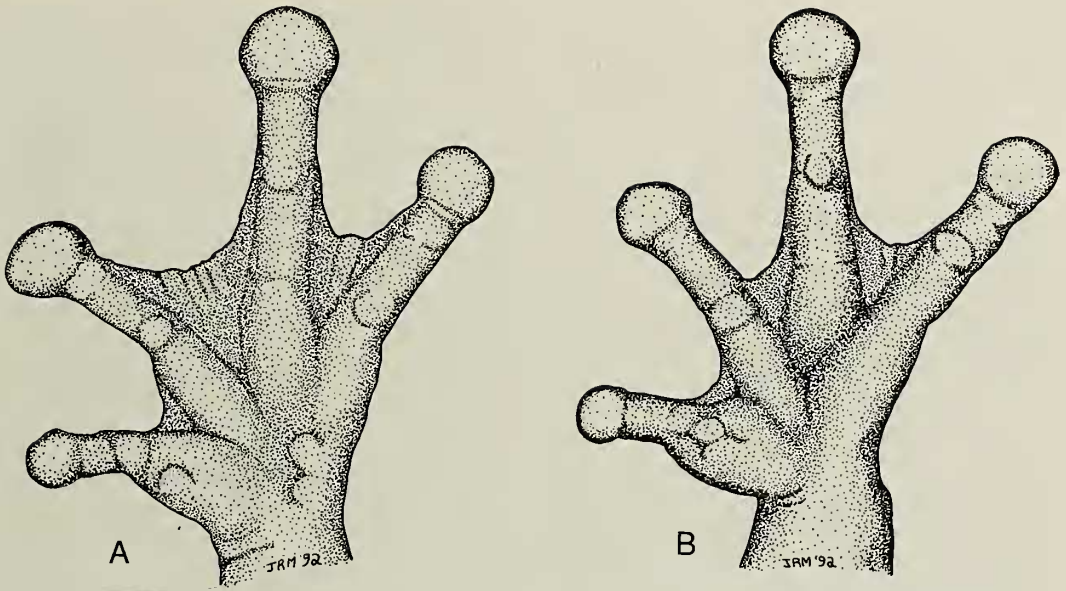


Fig. 2. Ventral aspect of the hand of (A) *Hyla chimalapa*, holotype, UTA A-13365, and (B) *Hyla xera*, holotype, UTA A-13387. Scale bar represents 2 mm.

ventrally from point above tympanum, becoming indistinct at point over the insertion of the arm.

Axillary membrane extending about one-fourth length of upper arm; ulnar tubercles present, weakly defined; dermal fold on wrist distinct; fingers long, slender, bearing expanded, slightly ovoid terminal discs; diameter of disc on third finger slightly larger than diameter of tympanum; relative length of fingers  $1 < 4 < 2 < 3$ ; fingers about half webbed with slight lateral fringe on all fingers except first, and medial surface of second; webbing formula  $I2^+ - 2^+ II2^+ - 2^+ III2^+ - 2^- IV$ ; subarticular tubercles indistinct except for round, elevated tubercles on first finger; supernumerary tubercles absent; palmar tubercle small, low, bifid; prepollex barely evident, lacking horny excrescence. Hind limb long; shank robust; tibia length 56.6 percent SVL; foot length 49.4 percent SVL; heels of adpressed limbs overlapping by one third length of shank; tibio-tarsal articulation extending to snout; tarsal fold distinct, extending full length of tarsus;

transverse dermal fold on heel absent; inner metatarsal tubercle small, oval, low; outer metatarsal tubercle absent; subarticular tubercles round, low, flat; supernumerary tubercles absent; toes long, slender, bearing round discs slightly smaller than those on fingers; toes about three-fourths webbed with lateral fringe except on outer edges of first and fifth toes; webbing formula  $I1 - 2^- III1 - 2^- III1 - 2^- IV2^- - 1V$ .

Skin on throat and belly granular, other surfaces smooth; cloacal opening directed posteroventrally at midlevel of thighs; cloacal sheath short. Vomerine teeth absent. Choanae small, subcircular, widely spaced. Tongue round, barely free posteriorly. Vocal slits extending from midlateral base of tongue nearly to angle of jaw; vocal sac single, median, subgular.

Measurements (mm): Measurements of the holotype followed by those of the paratype in parentheses. SVL 24.9 (23.3), tibia length 14.1 (13.6), foot length 12.3 (11.4), head length 8.4 (7.9), head width 8.6 (8.0), interorbital distance 3.7 (3.2), eyelid

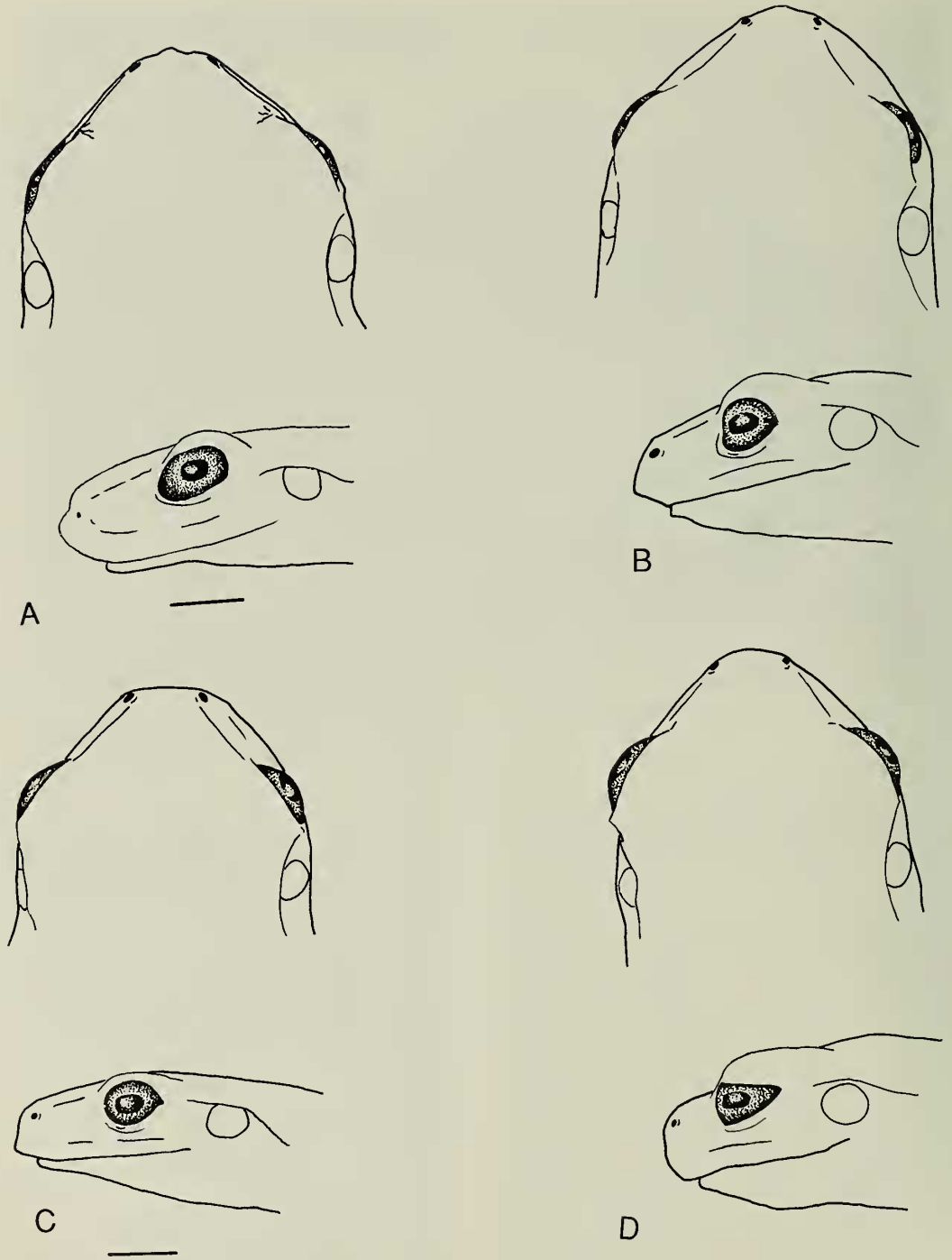


Fig. 3. Dorsal (upper) and lateral (lower) profiles of the snouts of (A) *Hyla chimalapa*, holotype, UTA A-13365, (B) *Hyla xera*, holotype, UTA A-13387, (C) *Hyla sumichrasti*, KU 100941, and (D), *Hyla smaragdina*, KU 75314. Scale bar represents 2 mm.

width 2.4 (2.5), eye–nostril distance 2.9 (2.7), eye diameter 3.2 (2.7), tympanum diameter 1.4 (1.4).

Color in preservative (70 percent ethanol after formalin): Dorsum of head, forearms, fourth and fifth fingers dark brown; dorsum of body, and hind limbs pale brown with few, scattered, dark brown flecks; dorsum of first and second fingers cream with fine brown stippling; axillary area and dorso-medial surface of arms cream; flanks, all ventral surfaces cream, except posterior surface of thighs, periphery of lower jaw and ventral surface of hands and feet cream with fine brown stippling; tarsal fold sharply separating dorsal and ventral colors on foot.

Color in life (from UTA Slide No. 133): Dorsal surfaces pale brown with scattered small dark brown flecks; head and tympanic area darker than other surfaces; tympanum pale brown with cream flecks; posterior surface of thigh and ventral surface of tibia red-orange; first finger pale yellow; flanks cream with brown stippling; iris dull gold with black reticulations.

*Variation.*—The measurements of the paratypes and the referred specimens are as follows (mm; range followed by mean in parentheses for males and females, respectively): SVL 20.3–23.6 (22.1), 18.4–26.6 (23.7); tibia length 10.9–12.3 (11.5), 10.8–14.2 (12.7); foot length 9.2–10.2 (9.6), 9.2–12.9 (11.2); head length 6.7–7.4 (7.2), 6.6–9.0 (7.8); head width 6.7–8.0 (7.3), 6.4–8.7 (8.0); eye–nostril distance 2.2–2.5 (2.4), 2.1–3.1 (2.6); tympanum diameter 1.0–1.2 (1.1), 1.1–1.6 (1.4). The proportions of the female specimens are given here rather than in Table 1 because we did not examine comparable numbers of females of the other species in the group: tibia/SVL 0.50–0.56 (0.54); foot/SVL 0.45–0.50 (0.47); head length/SVL 0.29–0.36 (0.33); head width/SVL 0.32–0.37 (0.34).

The paratypes and referred specimens are similar to the holotype in proportion and are similar in color in preservative. The ulnar tubercles are more distinct in these spec-

imens than in either the holotype or the paratopotype and the profile of the snout is more rounded; the protuberance illustrated in Fig. 3A is less pronounced in the paratypes.

*Distribution and ecology.*—*Hyla chimalapa* is known only from the southeastern Oaxacan Highlands, which includes the Sierra Atravesada (sensu Campbell 1984). This area is known locally as the *Chimalapa* region. All specimens have been collected between the town of Rizo de Oro and Cerro Baul—the highest peak in the region, except one (KU 179072) from the Sierra Atravesada. In August 1992, the Cerro Baul area still supported some disturbed cloud forest. This region is characterized by a complex mosaic of mesic cloud forest and relatively xeric pine-oak forests. The type locality is in cloud forest but there are no habitat notes associated with the remaining specimens and they may have been collected in the more xeric areas. The other species in the *H. sumichrasti* group inhabit moderately to extremely xeric habitats and it is possible that *H. chimalapa* occurs in the dry pine-oak forests of the region. The holotype and paratopotype were discovered at night along a wide, shallow stream at the edge of Colonia Rodulfo Figueroa. This stream flows swiftly over a sand and gravel substrate, forming numerous sandbars; in August 1992, these sandbars were covered by dense stands of young willows (*Salix* sp.) that were not present when the types of *H. chimalapa* were collected. Other species of anurans from this area include *Bufo marinus*, *B. valliceps*, *Rana maculata*, *Eleutherodactylus lineatus*, *E. leprus*, *Ptychohyla euthysanota*, and *Plectrohyla matudai*.

*Life history.*—The advertisement call, eggs, and tadpole of *H. chimalapa* are unknown. Adult females (CAS 170128, 170129) collected on 19 Apr 1972 contain partially developed ova, and another adult female (CAS 170123) from this date contains no apparent ova. An adult female (CAS 170114) obtained on 28 Apr 1972 contains

Table 1.—Comparison of selected measurements (mm), proportions, and morphological features of adult males of the *H. sumichrasti* group. Character abbreviations SVL, snout-vent length; TL, tibia length; FT, foot length; HL, head length; HW, head width. Range of values followed by means in parentheses.

Character	<i>H. sumichrasti</i>	<i>H. smaragdina</i>	<i>H. chimalapa</i>	<i>H. xera</i>
SVL	22.5–27.1 (24.5)	22.7–25.5 (24.0)	20.1–24.9 (22.1)	25.8–27.9 (26.8)
TL/SVL	0.43–0.53 (0.48)	0.43–0.49 (0.46)	0.50–0.58 (0.54)	0.46–0.50 (0.48)
FT/SVL	0.39–0.48 (0.42)	0.40–0.48 (0.44)	0.43–0.49 (0.45)	0.42–0.45 (0.43)
HL/SVL	0.29–0.33 (0.31)	0.30–0.33 (0.32)	0.31–0.34 (0.33)	0.29–0.32 (0.31)
HW/SVL	0.30–0.34 (0.32)	0.27–0.30 (0.28)	0.32–0.36 (0.34)	0.30–0.32 (0.31)
Snout (dorsal)	Bluntly rounded	Rounded	Acutely pointed	Acutely rounded
Snout (lateral)	Flattened	Rounded	Protruding	Bluntly rounded
Tarsal fold	Variable	Strong	Strong	Weak
Heel fold	Present	Present	Absent	Present
Tibiotarsal articulation	Orbit	Orbit	Snout	Orbit
Hand webbing	I2 <sup>+</sup> —2½ II2 <sup>-</sup> —2½ III2¾—2+IV	I2 <sup>+</sup> —2¾ II2 <sup>-</sup> —3 <sup>+</sup> III3 <sup>-</sup> —2+IV	I2 <sup>+</sup> —2 <sup>+</sup> II2 <sup>+</sup> —2 <sup>+</sup> III2 <sup>+</sup> —2-IV	I2½—2¾ II2 <sup>-</sup> —3 <sup>-</sup> III2½—2+IV
Vomerine teeth	Variable	Present	Absent	Absent
Palmar tubercle	Present	Present	Present	Absent
Ulnar tubercles	Absent	Absent	Present	Absent

a large number of mature ova, as does an adult female (CAS 163309) obtained on 12 Jun 1965. Only one male (KU 179072; 16 Jun 1972) appears to be in breeding condition. This specimen bears nuptial excrescences and a distended vocal sac.

*Etymology.*—The specific name is treated as indeclinable and refers to the spectacular and still incompletely surveyed *Chimalapa* region of eastern Oaxaca, from which this species is known.

*Remarks.*—The type locality may be reached by way of a long, tortuous drive along an unpaved road bearing NW from the small town of Rizo de Oro, Chiapas (NE of Tapanatepec on MX Hwy 190). Whether the type locality is in Oaxaca or Chiapas is a matter of local dispute; however, most maps show Cerro Baul to be in Oaxaca. This area is near the continental divide but Colonia Rodolfo Figueroa lies near the headwaters of the Río Mono Blanco, a tributary of the Río Negro (an Atlantic drainage).

The southeastern Oaxacan highlands have complex biogeographic relationships with the proximal highland areas of southern Mexico (Campbell 1984). This area shares

approximately the same number of amphibian species with the distant Sierra de los Tuxtlas of Veracruz as it does with the more proximal Sierra Madre de Chiapas (Campbell 1984), but no member of the *H. sumichrasti* group is known from these two regions. The Sierra Madre de Chiapas shares several disjunct, but poorly differentiated, species of cloud forest anurans with the southeastern Oaxacan highlands (Campbell 1984). It is possible that *H. chimalapa* will be discovered in this range, especially if it does inhabit the more widespread pine-oak forests (Breedlove 1973) of the region.

*Hyla sumichrasti* is known to the east of the southeastern Oaxacan highlands, in the xeric areas of the Sierra Madre del Sur and the Isthmus of Tehuantepec, and to the northwest from the more humid areas in the Central Depression and the cloud forests near Pueblo Nuevo Solistahuacan, Chiapas (Duellman 1970); this species has not been collected in the southeastern Oaxacan highlands. *Hyla sumichrasti* is more variable in its external morphology than the other members of the group. Variation exists both within and among populations in such char-



Fig. 4. *Hyla xera*, holotype (preserved), UTA A-13387.

acters as the presence of vomerine teeth, presence and degree of development of the tarsal fold, overall body proportions (Table 1) and details of color pattern evident in preserved specimens. For this reason we examined populations from both east and west of the southeastern Oaxacan highlands (Appendix 1) in preparing the diagnosis for *H. chimalapa* and the morphometric analysis. Despite the variation evident in *H. sumichrasti*, *H. chimalapa* is diagnosable on the basis of traditional external characters and proportions (Table 1, Fig. 5).

Duellman (1970) commented that *H. sumichrasti* and *H. smaragdina* may be conspecific, and cited the existence of a large distributional hiatus between the two species along the west coast of Mexico, despite the existence of suitable habitat in Guer-

rero. We here take the opportunity to report a series of specimens referable to *H. sumichrasti* collected by T. Pappenfuss in 1976 in Guerrero (Appendix 1). The discovery of this population does not support the hypothesis that *H. sumichrasti* and *H. smaragdina* are conspecific.

*Hyla xera*, new species  
Figs. 2B; 3B; 4

*Holotype*. —UTA A-13387 (original number JAC 6577), an adult male from 5.6 km SSW Zapotitlán Salinas, 1490 m, Puebla, Mexico; obtained on 1 July 1981 by J. A. Campbell.

*Paratopotypes*. —UTA A-13381–83, 13385, 13386, 13388 adult males, and UTA A-13384, an adult female, all collected with the holotype by J. A. Campbell.



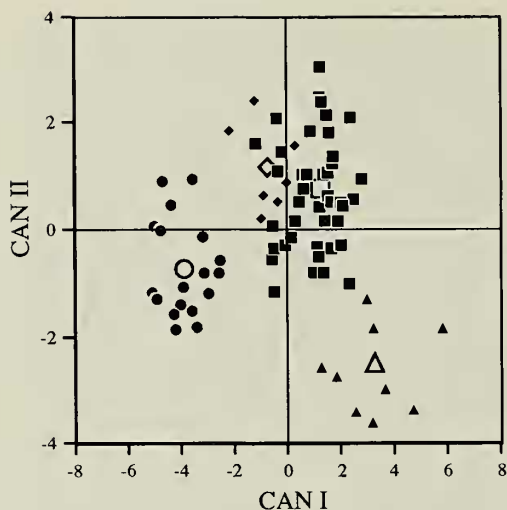


Fig. 5. Plot of canonical discriminant scores for all species in the *Hyla sumichrasti* group: *H. chimalapa* (triangles), *H. smaragdina* (circles), *H. sumichrasti* (squares), and *H. xera* (diamonds). Closed symbols represent individual scores, open symbols indicate group mean scores.

**Diagnosis.**—*Hyla xera* is referred to the *H. sumichrasti* group because it has a broad, flat head and large nasals that are in broad contact medially. This species can be distinguished from all other members of the group by the following combination of characters: (1) large SVL in adult males ( $\bar{X} = 26.8$ ); (2) a uniformly dull gray dorsum, with darker loreal and tympanic areas (in preservative); (3) tympanum distinct; (4) supratympanic fold thick, darkly colored; (5) snout acutely rounded in dorsal view, bluntly rounded in lateral view, sometimes with weak rostral keel; (6) dermal folds on wrist and heel present; (7) tarsal fold weakly developed; (8) fingers long, slender, about one-third webbed; (9) palmar tubercle absent; (10) tibiotarsal articulation extending to anterior margin of orbit; (11) vomerine teeth absent; (12) tongue cordiform; (13) row of ulnar tubercles absent; and (14) transverse dermal fold on heel present.

*Hyla xera* differs from *H. sumichrasti* by having a distinct tympanum with a thick, darkly colored supratympanic fold; snout

more rounded profile (Fig. 3B, C); palmar tubercle absent; fingers relatively longer; vomerine teeth absent; and SVL of adult males probably larger (Table 1; but see Duellman 1970). *Hyla xera* differs from *H. smaragdina* by being larger; snout less rounded in dorsal and lateral view (Fig. 3B, D); supratympanic fold thick, darkly colored; flecking on dorsum less extensive; tarsal fold weakly developed; palmar tubercle absent; fingers longer, more slender; and vomerine teeth absent. *Hyla xera* differs from *H. chimalapa* by being larger and having legs relatively shorter; snout more rounded in dorsal and lateral view (Fig. 3A, B); tarsal fold weakly developed; ulnar tubercles absent; palmar tubercle absent; fingers about one-third webbed; transverse dermal fold on heel present; and supratympanic fold thick, darkly colored.

**Description of holotype.**—Body robust; head as wide as body, slightly wider than long; head width 31.7 percent SVL; head length 30.0 percent SVL; snout acutely rounded in dorsal view with weak rostral keel, bluntly rounded in profile; distance from eye to nostril equal to diameter of eye; nostril four-fifths distance from eye to tip of snout; top of head flat, smooth; canthus rostralis distinct, rounded; loreal region slightly concave; lips thin; interorbital distance about 70 percent greater than width of eyelid; tympanum distinct without raised annulus, diameter about equal to distance from eye to tympanum; supratympanic fold thick, obscuring dorsal and posterodorsal margins of tympanum, extending posteriorly from orbit, posteroventrally from point above tympanum, becoming indistinct anterior to arm.

Axillary membrane extending about one-third length of upper arm; ulnar tubercles absent; dermal fold on wrist distinct; fingers long, slender, bearing expanded, round, terminal discs; diameter of disc on third finger slightly smaller than diameter of tympanum; relative length of fingers  $1 < 2 < 4 < 3$ ; fingers about one-third webbed, with-

out lateral fringe; webbing formula  $I2\frac{1}{2}-2\frac{3}{4}II2-3-III2\frac{1}{2}-2^{+}IV$ ; subarticular tubercles indistinct except for round, elevated tubercles on first finger; supernumerary tubercles absent except on prepollex; palmar tubercle absent; prepollex enlarged, bearing horny excrescence barely visible ventrally, covering posterior and dorsal portions of prepollex. Hind limbs long; shank robust; tibia length 48.7 percent SVL; foot length 42.2 percent SVL; heels of adpressed limbs overlapping by one-third length of shank; tibiotarsal articulation extending to anterior margin of orbit; tarsal fold absent; transverse dermal fold on heel distinct; inner metatarsal tubercle small, oval, low; outer metatarsal tubercle absent; subarticular tubercles small, round, slightly elevated on first and second toes, low, round, flat on fourth and fifth toes; supernumerary tubercles absent except on base of first toe; toes long, slender, bearing round discs about the same size as those on fingers; toes about three-fourths webbed, lacking lateral fringe except on fourth toe; webbing formula  $I1-2^{+}III-2\frac{1}{2}III1-2^{+}IV2-1V$ .

Skin on throat and belly granular, other surfaces smooth; cloacal opening directed posteroventrally at midlevel of thighs; cloacal sheath short. Vomerine teeth absent. Choanae small, slightly ovoid, widely spaced. Tongue cordiform, barely free posteriorly. Vocal slits extending from midlateral base of tongue to nearly to angle of jaw; vocal sac single, median, subgular.

Measurements of the holotype (mm): SVL 26.7; tibia length 13.0; foot length 11.3; head length 8.0; head width 8.5; interorbital distance 3.0; eyelid width 2.0; eye-nostril distance 2.7; tympanum diameter 1.6.

Color in preservative (70 percent ethanol after formalin): All dorsal surfaces dull gray except feet and thighs pale brown; loreal and tympanic areas darker than dorsum of head, dark coloring following and clearly demarcating supratympanic fold; supratympanic areas and dorsal surfaces of shanks with dull silver marbling; posterior surface of thigh

dull yellowish brown; flanks and all ventral surfaces dull cream; palmar and plantar surfaces cream with very fine gray stippling.

*Variation.*—The range of variation (mm; with means in parentheses) of the male paratopotypes are followed by those of the female paratopotype. SVL 25.6–27.9(26.9), 31.2; tibia length 12.5–13.3(12.8), 15.4; foot length 11.0–12.4(11.8), 13.1; head length 8.1–8.9(8.3), 9.1; head width 8.1–8.8(8.4), 10.3; interorbital distance 2.9–3.1(3.0), 3.5; eyelid width 1.9–2.4(2.1), 2.2; eye-nostril distance 2.7–2.8(2.8), 3.1; tympanum diameter 1.3–1.8(1.5), 1.6. Variation in body proportions are summarized in Table 1 and, along canonical axes, in Fig. 5. The coloration (in preservative) of all paratopotypes is very similar to that of the holotype, except UTA A-13382 (male) and UTA A-13384 (female), which have distinctive dull silver and dull brown marbling on the flanks and posterior surfaces of the shanks and tarsi. The transverse dermal fold and tarsal fold are weakly developed in this species and appear to be absent in some individuals in the type series.

*Distribution and ecology.*—*Hyla xera* is known only from the type locality. This area supports arid tropical scrub (sensu Leopold 1950) and is characterized by scattered mesquite trees (*Prosopis*), other leguminous trees, and many species of cactus. Patches of thorn forest and tropical deciduous forest occur locally, especially in the draws. No permanent water occurs naturally in the Zapotitlán Valley, even the largest stream draining the valley is seasonal. Most specimens (UTA A-13381–87) were taken by day from beneath rocks along a small stream; one male (UTA A-13388) was calling from a rock in this stream at night. Other species of anurans taken from this region are *Bufo occidentalis*, *Eleutherodactylus nitidus*, and *Scaphiopus multiplicatus*.

*Life history.*—Little is known about the life history of *H. xera*. The advertisement call, eggs, and tadpole remain undescribed. All male specimens reported herein have

well developed nuptial excrescences and may be in breeding condition; however, their vocal sacs are not distended. The oviducts of the female paratopotype contain many well-developed ova.

*Etymology.*—The specific name is derived from the Greek *xeros* meaning dry, in allusion to the desert habitat of this species.

*Morphometric analysis.*—We performed a stepwise DFA of 11 morphometric variables (see Materials and Methods) on adult males of *H. sumichrasti* (Chiapas,  $n = 16$ ; Oaxaca: Portillo Nejapa,  $n = 13$ ; Oaxaca: Mitla,  $n = 14$ —populations combined for analysis), *H. smaragdina* ( $n = 18$ ), *H. xera* ( $n = 7$ ), and *H. chimalapa* ( $n = 8$ ). Morphometric variables 1, 2, 3, 5, and 10 varied significantly among groups ( $F < 0.001$ ) in the stepwise analysis and were included in the canonical discriminant analysis. Group means were different ( $F < 0.001$ ) at each step in the five-step model and 100 percent of the variation was displayed on three canonical axes; the first two axes displayed 95 percent of the variation (CAN I, CAN II; Fig. 5). The standardized (pooled within group variances) coefficients for the canonical variables were: CAN I (CAN II) = 1:  $-1.62$  (1.05), 2:  $0.95$  ( $-0.78$ ), 3:  $-0.77$  ( $-0.02$ ), 5:  $1.63$  (0.60), 10:  $-0.17$  ( $-0.36$ ).

All individuals of *H. xera*, *H. chimalapa*, and *H. smaragdina* were correctly classified in the jackknifed classification matrix of the five-step model. Three individuals of *H. sumichrasti* were misclassified as *H. xera* and one as *H. chimalapa*.

*Hyla smaragdina* is well separated from the other species along CAN I and *H. chimalapa* is well separated from the other species along both axes. *Hyla sumichrasti* and *H. xera* are significantly different in this analysis, albeit weakly separated from one another along the first two canonical axes; although these two species are similar in overall proportions (Fig. 5), they are clearly distinguishable on the basis of other external characters.

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## Appendix 1

Comparative material examined (all from Mexico):  
*Hyla smaragdina*: *Sinaloa*: 1.6 km E Santa Lucía, 1280 m (KU 68719); Santa Lucía, 1097 m (KU 75295–

333); 2.2 km NE Santa Lucía, Hwy 40, 1157 m (KU 78380–82).

*Hyla sumichrasti*: *Chiapas*: Linda Vista, ca 2 km NW Pueblo Nuevo Solistahuacán, 1675 m (KU 57857–85). *Guerrero*: Sierra Madre del Sur, 3.1 km SW Rio Santiago on road to Atoyac, 762 m (CAS 143116–

143149). *Oaxaca*: 14 km E El Camaron, 1240 m (KU 100934–46); 6.0 km N Mitla (UTA A-2827, 2881–95); 8.8 km N Mitla (UTA A-2916–19); 6.4 km E Mitla (UTA A-2920–29, 2931–33, 3255–56, 3284); 8.8 km E Mitla (UTA A-4673–77); 6.0 km ENE Mitla (UTA A-5889–90).